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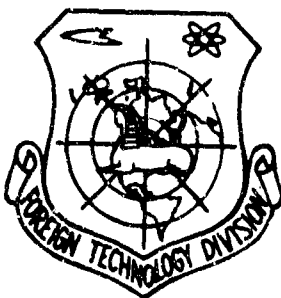
## FOREIGN TECHNOLOGY DIVISION



### EQUIPMENT FOR DETERMINING THE SIZE OF AEROSOL PARTICLES IN LIQUID DISPERSION

by

A. I. Danilov and Yu. P. Pokhitonov



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By: A. I. Danilov and Yu. P. Pokhitonov

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## ABSTRACT

Microscope attachments are described which are for use in sampling liquid aerosols and in their photoregistration, thus facilitating calibration of atomizers and investigation of the dispersion condition of an aerosol cloud in a chamber. A schematic (Fig 1) presents the basic setup, and variations for other uses are suggested; a photograph shows the exterior of the microscope (see Fig. 2). Orig. art. has: 3 figures.

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Fig. 1. Schematic of equipment for sampling, measuring, and photoregistering of aerosols

- 1 - Ocular; 2 - micro-objective;
- 3 - sedimentation cell; 4 - sample plate; 5 - precipitator funnel;
- 6 - air suction funnel; 7 - anode;
- 8 - cathode; 9 - aerosol-air feed channel; 10 - air suction channel;
- 11 - optical axis of microscope;
- 12 - aerosol precipitation plate;
- 13 - cover slide of guide plate;
- 14 - mirror; 15 - heat filter;
- 16 - ZS-12 filter; 17 - field diaphragm; 18 - collimator; 19 - incandescent bulb.



Fig. 2. General view of equipment for aerosol microscopy

- 1 - Sample plate; 2 - precipitation funnel; 3 - suction funnel;
- 4 - guiding plates; 5 - CI-1 illuminator bulb; 6 - fastening screw for illuminator bulb;
- 7 - mirror; 8 - light trap;
- 9 - anode contact; 10 - cathode contact; 11 - body of dark-field chamber.

## EQUIPMENT FOR DETERMINING THE SIZE OF AEROSOL PARTICLES IN LIQUID DISPERSION

A. I. Danilov and Yu. P. Pokhitonov

It is known that in medicine, especially in the treatment of the upper respiratory channels in professional hygienic practice for disinfection there is wide use of aerosols. In recent years there is successful development going on in the matter of aerosol vaccination against infectious diseases. With the aid of aerosols of bacteria and viruses it became possible to explain the pathogenesis of infections.

One of the main conditions in the study of the effectiveness of the action of aerosol particles (antibiotics, pharmacological preparations, infection agent, vaccine, etc.) is the determination of their concentration and dispersion. The instruments used for this purpose are the domestic ultramicroscopes (1, 2) which are quite suitable for the study of the liquid aerosol particles, but which demand a definite preparation and subsequent mathematical treatment of the visual data. Other, very precise, but quite complicated methods are the photographic, oscillation of the direct photographing in the aerosol chamber, and automatic, which may be used only in special laboratories.

For determining the dimensions of the aerosol particles most widely used are the sedimentation methods in the use of which the aerosol particles settle on glass bases covered with a thin layer of smeared-on-substance-soot, paraffin or other contrasting substance (3). Notwithstanding the wide use of the sedimentation methods the use of many of them is limited, especially in the investigation of liquid aerosols under the conditions of the exposition chambers. Determined difficulties are connected also with the lack of contrast of the liquid aerosol particles and their tendency to rapid evaporation (6).

The method proposed by us is based on the principle of the hot field used in the macrophotography of objects of little contrast (4, 7). It consists of the following (Fig. 1): the axis of the source of the light is set at an angle of 12 to 45° to the optical axis of the microscope, in connection with which into the

objective of the microscope direct light does not fall, but the image is formed through the diffraction of the light by the object of investigation. In Fig. 2 there is shown the device for picking up and registering specimens of the aerosol particles. The basic units of the device are the microscope, the photoattachment (in this case MFN-10), and the darkfield chamber, which inside is covered by black velvet paper. The chamber has on top two openings (for the illuminator OI-19 and for illuminating the object). Inside the chamber there are mounted a light filter, the SZ-12, and a mirror directing the light beam at an angle of 42 to 45° to the optical axis of the microscope. The chamber is fastened to a cantilever on the upright of the microscope. A sedimentation tray, the basic part of the device, is fastened under the darkfield chamber to lugs on the preparation feeder and consists of object movable plate included between 2 directing plates on which there is the precipitation funnel (on top) and the funnel for drawing off of the air (below). The object plate can be shifted horizontally from the objective to the funnels and back. The base for the settling of the aerosol particles (cover glass) is set in the window of the object plate. The directing plates have windows. The upper one is covered by a coating of glass. When the object windows and the directing plates coincide there is formed a chamber the depth of which correspond to the working cutout of the microobjective. For the hermetic sealing of the place of joining of the covering glasses and plates there is applied a layer of vaseline. The following important part is the airing device (aspirator).

The technology of working with the device is reduced to the following. At the moment of intake of the sample of the aerosol the object plate moves out in a way to put the base between the funnels through which the air is drawn with the aerosol particles. Then for the inspection the base is set under the objective of the microscope, i.e., it lines up with the windows of the controlling plates and the investigation is done visually or by photographing. The whole procedure beginning with the replacing of the base on the plate and ending with the photographing with a certain amount of facility takes not more than 1-3 minutes. In microscopy for determining the dispersion of the aerosol particles, previously, of course, it is necessary to calibrate the ocular micrometer.

#### Possible variants of the work with the given adaptation.

**Variant 1.** One prepares only the sedimentation tray which is mounted on the lugs of the preparation conductor fastened to the stand of the microscope. In this case one dispenses with the need of preparing the darkfield chamber. The observation and photographing of the aerosol particles is accomplished in the passing light and not in accordance with the scheme shown in Fig. 2. For contrast effect of the aerosol particles on the base there is spread a thin coat of cedarwood oil.

**Variant 2.** The outfit is set up in accordance with the plan shown in Fig. 1. The base is dry and is carefully cleaned of grease. The most effective precipitation is obtained in this case if in the funnels of the sedimentation chamber there are mounted electrodes connected to a generator of dc voltage (10,000-12,000 v). In this way there is assured a charge of aerosol particles, which due to the

electrostatic field are deposited to a greater extent on the base<sup>1</sup>. However, the depositing is possible even without the high-voltage device.

The advantage of the proposed equipment, in our opinion, consists in this - in the first place along with the simplicity of the preparation there is the possibility of using any biological microscope. In the second place one gets the possibility of picking up samples both from the nozzle of the atomizing device, which is especially important in evaluating it, and from any place of the exposure camera and at any time, and this enables one to evaluate the aerodynamic displacements. In the third place there is absent the evaporation (in accordance with our observations within the limits of one hour) of the liquid aerosol particles. In the fourth place there is assured the possibility of photographic recording, eliminates the subjective evaluation of the dispersion of the aerosol particles. Finally for each sampling there is used a time minimum.

In conclusion one should note that we obtained standard reproducible results with the given device with checking for dispersion in the flow ultramicroscope the VDK-4. The evaluation of the device was accomplished with the atomizing of liquid culture inactivated vaccine against ornithosis and tick encephalitis, meat peptone broth, culture medium 199, saline solutions, etc. in the aerosol chamber and the ultrasonic generator. The form of the liquid aerosols, as is seen from Fig. 3 does not change or changes so insignificantly for the particles of the size 1 to 3  $\mu$  that one can disregard this (5). The aerosol particles of greater size, however (10  $\mu$  and larger) when settling on a flat surface flatten and take on the form of a "lens." In this case it is necessary to introduce a correcting coefficient.

### Conclusions

An adaptation for a microscope is described which makes it possible to take samples of liquid aerosols and their photoregistration which can be used for calibration devices and the studying of the state of the aerosol cloud in dispersion under chamber conditions.

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<sup>1</sup>The effectiveness of the depositing of the aerosol particles with the aid of the given device as compared with the other instruments will be explained in a subsequent communication.

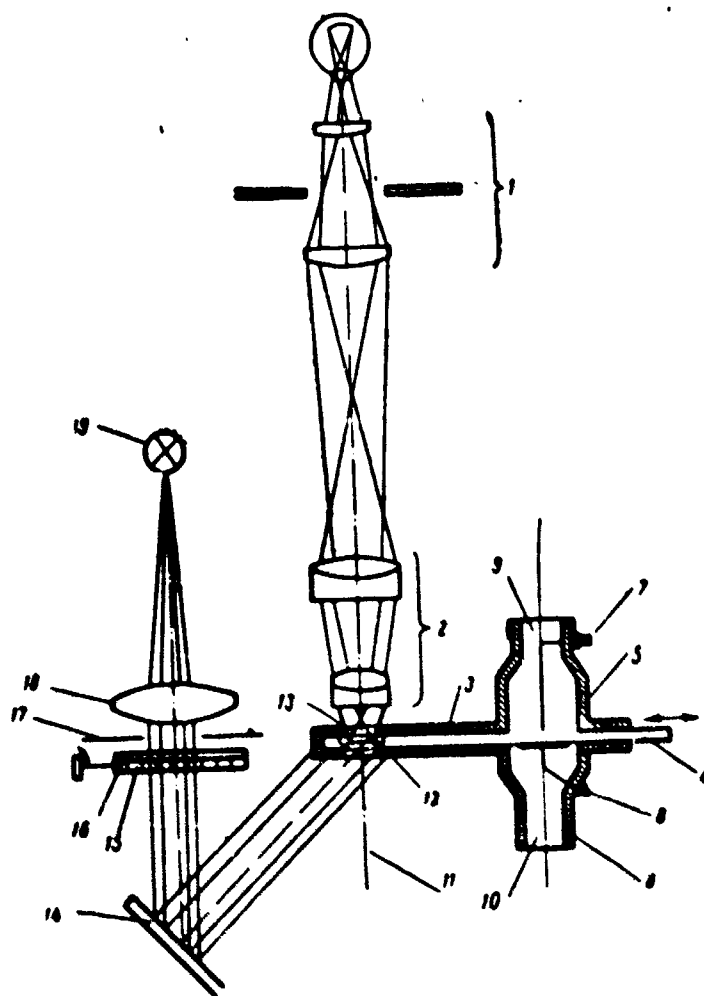
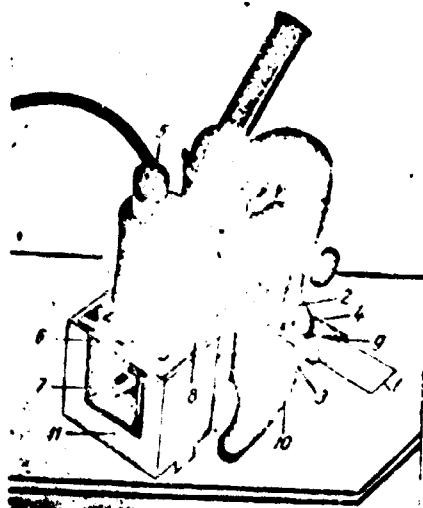


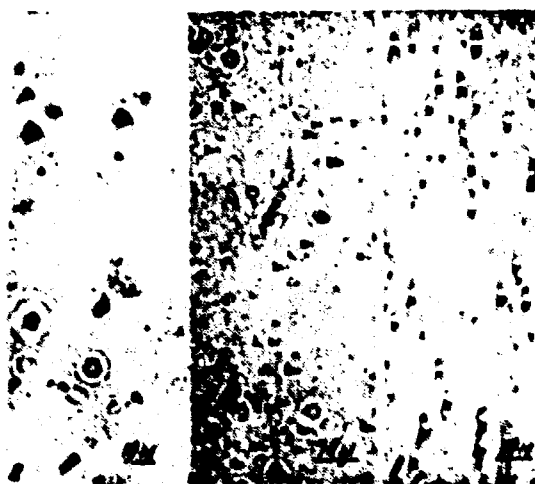
Fig. 1. Sketch showing the principle of the equipment for sampling, measuring, and photoregistering of aerosol particles.

1 - ocular; 2 - microobjective; 3 - sedimentation tray; 4 - object plate;  
 5 - precipitation funnel; 6 - funnel for drawing off air; 7 - anode; 8 - cathode;  
 9 - aerosol-air feed channel; 10 - channel for drawing off air; 11 - optical axis  
 of microscope; 12 - aerosol precipitation base; 13 - cover glass of guide plate;  
 14 - mirror; 15 - heat filter; 16 - ZS-12 filter; 17 - field diaphragm; 18 - colli-  
 mator; 19 - incandescent bulb.



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Fig. 2. General view of adptation for aerosol microscopy.  
1 - object plate; 2 - precipitation funnel; 3 - draw-off  
funnel; 4 - guiding plates; 5 - OI-19 illuminator bulb;  
6 - illuminator fastening screw; 7 - mirror; 8 - light trap;  
9 - anode contact; 10 - cathode contact; 11 - body of  
darkfield chamber.



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Fig. 3. Microphotography of aerosol particles obtained with an atomizer in the  
taking of a sample from the nozzle of the atomizer (a); on the atomizer in taking  
of sample from the exposure chamber (b); and on the ultrasonic generator of  
aerosols (c).

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